

A System Engineering Approach to Strategic Partnership Development: A pilot study with NASA's Orbiting Carbon Observatory-2 (OCO-2) and the National Laboratory for Agriculture and the Environment (NLAE)

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A National Imperative Called Out

Earth observations from satellites and in situ collection sites are critical for an ever-increasing number of applications related to the health and well being of society. The committee found that fundamental improvements are needed in existing observation and information systems because they only loosely connect 3 key elements:

(1) the raw observations that produce information; (2) the analyses, forecasts and models that provide timely and coherent syntheses of otherwise disparate information; and (3) the decision processes that use those analyses and forecasts to produce actions with direct societal benefits.

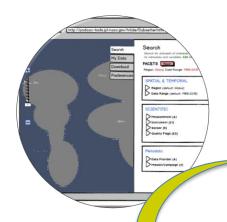
Taking responsibility for developing and connecting these three elements in support of society's needs represents a new social contract for the scientific community.

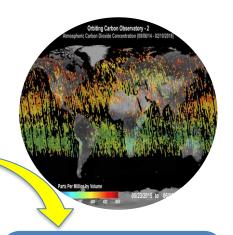
--Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond, 2007

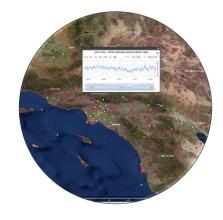
End-To-End Data Lifecycle CONSIDERATIONS • Data Processing/Computation • Data Triage • Algorithm Development • Data Representation/Metadata Rapid Turnaround Onboard Provenance Science Planning Feature and (ground- and flight-• Data Formatting Event. System Interface based) Detection • Data Storage Services Workflow Relay Satellite • Data Management Spacecraft and Information Modeling Simple Scientific Distributed Services Information Instruments Object Data Distribution Visualization • Data Integration Spacecraft / lander • Data Discovery and Analysis Massive, Distributed Data Archives of Observations and Models Massive Data Analysis Applications Community Science Data Processing/Triage Massive Computation Data Scalable Acquisition Analysis of Research Archives and Command Massive, Community Distribute Data Science Team

Well planned and implemented process for data lifecycle that is not necessarily optimized for all the communities and users.

A System Engineering Approach







User Assessment

Identification
Requirements
Process
Compatibility



Product Development

Data Tool Interface Test



<u>Implementation</u>

Schedule

Adoption

Evaluation

Operation

Key to Success:

- Dedicated personnel (end to end support)
- Expertise in Mission Key point development (guidance and direction)
- Customer base and needs development (feedback & documentation)
- Proposal and plan development (roadmap)
- Product Pipeline (Deliverables)

OCO-2 Science Data Application Development

Early Adopter and User Development (Years 2014-2016)

Apr 2014	OCO-2 1st Applications Workshop (Pre-launch) Outcome: Set of potential applications and users to follow up
Jul 2 2014	OCO-2 Launch from VAFB
Sept 2014	Delivery of Final version of OCO-2 Application Plan
Dec 2014	Active Campaign to recruit Early Adopters
Jan 2015	Identify partner and discuss collaborative details
Mar 2015	MOU drafted
June 2015	MOU signed with NLAE/ARS/USDA
Sept 2015	OCO-2 2 nd Applications/1 St Users Workshop
Dec 2015	-Community Outreach Telecons and Meet up at AGU -SMAPVEX/CFIS campaign planning
Jan 2016	Initial science results discussion from 9/15 workshop
Mar 2016	Development of draft paper for RSE

User Assessment
Requirements
Process
Obstacles
Compatibility

OCO-2 Science Data Application Development

Early Adopter and User Development (Years 2016-present)

Jul-Aug 2016 CFIS joins SMAPVEX 16 Campaign in N. Dakota, Nebraska, Illinois and Iowa 3rd Science Data Application Workshop/2nd Sep 2016 Users Meeting, held at USDA HQ Oct 2016 Progress report at OCO-2 Science Team Mtg Nov 2016 **RSE Paper published** Dec 2016 Post Workshop Mtg at AGU- Status Update Jan 2017 OCO-2/OCO-3 Compatibility Study Mar 2017 -Programmatic investment in further development -New User outreach Jun 2017 -ESD signed Flight Directive for Applications Development -1st Joint OCO-2/OCO-3 Science Data Application Meeting Jul-Aug 2017 CFIS Flight campaign

Data Processed and Tower data/Satellite data

User Assessment Identification Requirements **Process** Compatibility

> **Product Development** Data Tool Interface Test

Feedback loop in real time!

Oct 2017 Proposed developed product and ingestion with current models and products

analysis commenced

Sep 2017

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Summary

- 1) Recognition and acceptance that not all data users are alike.
- 2) There is a need to customized approach, but the steps in the approach should be clear and methodical.
- 3) Active and consistent communication is essential for progress.
- 4) This is a time investment that will have long term pay off (e.g. OCO-3).

OCO-2 observations and data <u>open up new possibilities</u> for assessment of agricultural systems through both the CO2 and SIF data.

These are measurements we have not had at a large scale to compare to our flux tower data, to determine how information can be linked to provide a more robust estimate of global productivity.

- Dr. Jerry Hatfield
Director of National Laboratory for Agriculture and the Environment, USDA

Thank you!

For more information, feel free to contact me: Karen.yuen@jpl.nasa.gov